PROF. BUCKLEY, State Geologist of Texas, has published a synopsis of the work done under his auspices during the past season, and remarks that fifty-four counties have been visited by himself and assistants. The results of his investigations show that Texas has vast deposits of iron and coal, of much greater extent than had been anticipated. Both are of excellent quality, and in some cases they occur near together. He has also found an abundance of salt, gypsum, and a wide range of copper ores. Other valuable minerals are roofing slate, marble, soapstone, &c.

THE Engineer Department of the United States Army has issued a "Catalogue of Plants collected in the years 1871, 1872, and 1873, with Descriptions of New Species." This is a portion of a series of publications brought out under the same auspices, being a report of geographical and geological explorations and surveys west of the 100th meridian, under the charge of First-lieutenant G. M. Wheeler.

WE are pleased to learn from the "Tenth Report of the Board for the Protection of the Aborigines in the Colony of Victoria," that the condition of the aborigines from the foundation of the colony was never so prosperous as at the present time. Very successful experiments at hop-growing have been made in some of the districts allotted to the natives, who take kindly to the light and comparatively well-paid work. The cultivation of hops will be extended to other districts. Considerable success has also been attained in the education of the children.

DR. JOHN DOWSON has sent us two pamphlets of which he is the author: "Thoughts, Philosophical and Medical, selected from the Works of Francis Bacon," and "A Sketch of the Life and Works of Erasmus Darwin, M.D., F.R.S." H. K. Lewis, Gower Street, is the publisher.

THE *Quarterly Journal* of the Meteorological Society, just issued, contains a number of papers read during the last session of the Society, abstracts of most of which have appeared in these pages.

THE "Proceedings of the Belfast Natural History and Philosophical Society" for 1872-3-4 have been published. Among the papers of scientific interest are the President's (Mr. J. J. Murphy's) addresses, "On Cosmological Science," and "On the present state of the Darwinian Controversy;" Prof. Everett "On Mirage," published in NATURE, vol. xi. p. 49; "On some New Methods of Chemical Analysis," by Prof. Hodges; "On the Solar Spots," by Mr. Murphy; "On Rainbow, Halos, and Coronæ," by Prof. Purser; "On Underground Temperature," by Prof. Everett; "On the Origin and Metamorphoses of Insects," by Mr. Murphy; "On the Composition of an Inflammable Gas issuing from below the Silt-bed in Belfast," by Dr. Andrews, F.R.S.

WE have received two reprints from the "Proceedings" of the Liverpool Geological Society, 1873-74: "The Metamorphic Rocks of the Malvern Range and the Strata derived from them," by Dr. C. Ricketts, F.G.S.; and "Tidal Action as a Geological Cause," by Mr. T. Mellard Reade, C.E., F.G.S.

IT is gratifying to see, from the Seventh Annual Report of the Eastbourne Natural History Society, that the Society is, on the whole, in a flourishing condition. It is doing very satisfactory work in the collection and arrangement of the fauna and flora of its district.

THE additions to the Zoological Society's Gardens during the past week include a Peregrine Falcon (*Falco peregrinus*), European, presented by Mr. A. F. Ross; a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, purchased; and eight Canadian Beavers (*Castor canadensis*) from North America, deposited.

THE ROYAL SOCIETY MEDALS

WE have already announced the names of those to whom the Royal Society Medals have been awarded; the following is the official account of the presentation by the Vice-President and Treasurer, Mr. Spottiswoode, at the Anniversary Meeting on the 30th ult. :—

The Copley Medal has been awarded to Prof. Louis Pasteur, one of our foreign members, "for his researches on Fermentation and on Pebrine."

Prof. Pasteur's researches on fermentation consist essentially of two parts: the first part, in which he enters exhaustively into the examination of the products formed in this process; and the second, in which he takes up the question of the cause of fermentation.

Previous observers had noticed the production, in solutions of sugar which had been fermented, of substances other than the two commonly recognised, alcohol and carbonic acid; but it remained for Pasteur to show which were essential and which were occasional products. In the series of able papers contributed to the *Comptes Rendus* and to the *Annales de Chimie et de Physique*, he proved conclusively that succinic acid and glycerine were always found in fermented solutions of sugar, while lactic acid and acetic acid, although occasionally present, were not always so. He also showed that, in addition to these substances, a part of the sugar was converted into cellulose and fat.

The study of the products formed during fermentation opened the way to the second part of the research, viz., the cause of fermentation.

It had been found that certain solutions, when exposed to the air, soon became full of living organisms; and Pasteur's experiments led him to support the view that these organisms originated from the presence of germs floating in the air. He found that no living organisms were developed if care were taken to destroy completely all those which might be present in the solution, and if the solutions were then carefully sealed up free from air. Nor was it necessary to exclude the air, provided that pure air, free from germs, were admitted. By passing the air through red-hot tubes or through gun-cotton before reaching the solutions, he found that the development of organisms, in such boiled solutions, did not take place. An exception to this was noticed in the case of milk, which required to be heated to a higher temperature than the boiling-point of water at atmospheric pressure. Pasteur showed that this was connected with the alkaline reaction of milk, for in all cases in which the development of life was prevented by heating to the boiling-point of water, the solutions had a faintly acid reaction—but that when this was neutralised by carbonate of lime, the solutions then behaved like milk.

Prof. Pasteur also examined the gun-cotton through which the air had been passed; and he found, among other things, certain cells to which he attributed the power of causing the growth of organisms in solutions. By sowing some of these cells in solutions which previously had remained clear, and finding that such solutions speedily became turbid from the growth of living organisms, it was proved that the air which had passed through the gun-cotton had lost its property of causing the development of life in solutions, because the germs which the air contained had been stopped by the gun-cotton.

The result of the second part of the research may be thus summed up :—

1. No organisms are developed in solutions if care be taken to prevent the possibility of the presence of germs.

2. This negative result does not depend upon the exclusion of oxygen.

3. The matter separated from ordinary air is competent to develop organisms in solutions which previously had remained unchanged.

Not less important were the results of Pasteur's experiments respecting the chemical functions of the ferment.

It had been held that the entire ferment was in a state of putrefactive decomposition, and induced a similar decomposition in the sugar with which it was in contact.

In corroboration of this view, it was stated that ammonia (a product of the decomposition of albuminous substances such as those present in the ferment) is always found in liquids which are undergoing fermentation.

Pasteur proved that the ammonia in fermenting liquids diminishes in quantity in proportion as the process advances, and that the yeast-cells increase and grow while forming complex albuminous substances at the expense of the ammonia and other

aliments which are supplied to it. He found that, in addition to ammonia and sugar, the cells require mineral substances, such as phosphates and other constituents, such as are present in the organism of every healthy and growing yeast-cell.

In short, he proved that those conditions which are most favourable to the healthy growth and development of the yeast-cells are most conducive to the progress of fermentation, and that fermentation is impeded or arrested by those influences which check the growth or destroy the vitality of the cell.

The above results are but samples of the fruits of Pasteur's long series of researches in this subject. Many and many an able investigator had worked in the same field; and such were the difficulties they encountered, that Dumas himself recommended Pasteur not to waste his time in working at so hopeless a subject.

To the biologist, two of Pasteur's researches are of very great interest and importance. He has shown that *fungi* find all the materials needed for their nutrition and growth in water containing an ammonia salt and certain mineral constituents, and devoid of any nitrogenised organic matter; and he has proved that all the phenomena presented by the destructive silkworm epidemic, the *pebrine* (even the singular fact that it is hereditarily transmitted through the female, and not through the male), are to be explained by the presence of a parasitic organism in the diseased caterpillars.

The medal was received for Prof. Pasteur by the Foreign Secretary of the Society.

The Rumford Medal has been awarded to Mr. J. Norman Lockyer, F.R.S., "for his Spectroscopic Researches on the Sun and on the Chemical Elements."

Mr. Lockyer has long been engaged in spectroscopic researches on the sun. His first observations were directed to a scrutiny of the spectrum of sun-spots as compared with that of the general surface, with a view to bring evidence to decide between two rival theories respecting their formation. In the course of the paper in which his first observations were described, and which was read before the Royal Society on November 15th, 1866, he asks, "May not the spectroscope afford us evidence of the existence of the 'red flames' which total eclipses have revealed to us in the sun's atmosphere, although they escape all other modes of examination at other times?"

The spectroscope he then employed proved to be of insufficient dispersive power for his researches, and he was induced to apply to the Government-Grant Committee of the Royal Society for aid to construct one of greater power. This aid was accorded, and the instrument was delivered, though not quite complete, on the 16th of October, 1868. On the 20th his efforts were crowned by the detection of a solar prominence by means of the bright lines exhibited in his spectrum. An account of this discovery was immediately communicated to the Royal Society and to the French Academy of Sciences.

Meanwhile had occurred the total solar eclipse of August 18th, 1868, to observe which various parties had gone out armed with suitable instruments, and especially with spectroscopes, for determining the character of the hitherto unknown spectrum of the prominences; and the first-fruits of their labours had reached Europe, showing that the spectrum in question is one of bright lines. It occurred to M. Janssen, who had observed with eminent success the spectrum of the prominences during the eclipse, that the same mode of observation might enable one to detect them at any time, and he saw them in this manner the very next day. The first account of this discovery, which was sent by post, did not, however, reach the French Academy until a few days after the communication of Mr. Lockyer's notice; so that nothing interferes with the perfect independence with which these two physicists established the possibility of detecting the prominences at any time.

A discovery like this opened up a new field of research, which Mr. Lockyer was not backward in exploring. One of the first-fruits of the application of the method was the discovery of a continuous luminous gaseous envelope to the sun, which he calls the chromosphere, of which the prominences are merely local aggregations. Evidence was further obtained of gigantic convulsions at the surface of the sun, which were revealed by slight alterations of refrangibility in the lines, observed in a manner similar to that in which Mr. Huggins had determined the relative velocity of approach or recess of the Earth and Sirius.

The interpretation of spectroscopic solar phenomena required a re-examination in several respects of the spectroscopic features of artificial sources of light. Among these researches special mention must be made of Mr. Lockyer's classification of the lines due to the metals of the electrodes between which an induction discharge was passed, according to their "length," *i.e.*, the distance from the electrodes to which they could respectively be traced. This led to the explanation of various apparent anomalies as to the presence or absence of certain dark lines in the solar spectrum, and to the detection of additional elements in the sun, especially potassium, an element which, though so common on the earth and so easily detected by spectral analysis, had not previously been proved to exist in the sun, because the attention of observers had been turned in a wrong direction, as was shown by these researches.

Nor was it only in relation to solar physics that these researches bore fruit. They led to a *quantitative* determination in many cases, by means of the spectroscope, of the proportion of the constituents in an alloy, and afforded new evidence of the extent to which impurities are present even in substances deemed chemically pure.

The medal was received by Mr. Lockyer.

A Royal Medal has been awarded to Mr. Henry Clifton Sorby, F.R.S., "for his researches on slaty cleavage and on the minute structure of minerals and rocks; for the construction of the Micro-Spectroscope, and for his researches on colouring-matters."

The principal grounds on which Mr. Sorby's claims to a Royal Medal rest are the following:—

1. His long-continued study, and his successful application of the microscope to the solution of problems in petrology.

2. His employment of the prism in conjunction with the microscope for the analysis of the colours transmitted by substances, as well organic as inorganic.

Though Mr. Sorby's labours during the last ten years have been more particularly devoted to observations of the latter class, his work, extending over a period that commenced in 1849, is represented in the Catalogue of Scientific Papers (limited by the year 1863) by no less than forty-seven memoirs. Among the more remarkable of these must be mentioned the reports to the British Association and the contributions to the *Philosophical Magazine* (1853, 1856, 1857), in which he grappled with the subject of slaty cleavage, and helped to establish the explanation that cleavage was the result of greater relative condensation of the material in a direction perpendicular to the cleavage, due in the case of rocks to mechanical compression in that direction—an idea that met with immediate illustration from other experimentalists.

His memoirs on the temperatures and pressures at which certain rocks and minerals were formed (in the Geological Society's *Journal*, 1858), founded on the relative volume of the liquid and vacuous portions of microscopic hollows, or, again, on the character of microscopic substances mingled with the mineral matter he investigated, convinced the geologist that he had to take into account the action of water under high pressures and at high temperatures in explaining the formation of granitoid rocks. And the refinement of the methods that Mr. Sorby employed for making his rock-sections at Sheffield has made those methods the models sought after by the now large school of Continental and English microscopic petrologists.

His applications of spectroscopic methods to the microscope fall more strictly within the limit of ten years, as they have been worked out since 1867, when Mr. Sorby first described his adaptation of the spectroscope to the microscope, as carried out by Mr. Browning.

The observations he has made with this instrument, and generally by combining optical examination with the use of chemical reagents, have extended over a very wide range—such as the recognition of blood-stains, of adulteration in wine, the means of discriminating among the compounds of certain of the metals, chiefly of zirconium, titanium, and uranium, by the aid of blow-pipe beads—and finally to the elucidation, to a considerable extent, of the causes of the complexity in the tints exhibited by plants in the different stages of development of their annual foliage and flowers.

These are only some of the more important of Mr. Sorby's contributions to science; and they are characterised by an untiring application of the methods of experimental research to a great variety of subjects suggested by a very ingenious and active mind.

The medal was received by Mr. Sorby.

A Royal Medal has been awarded to Prof. William Crawford Williamson, F.R.S., "for his contributions to Zoology and Palæontology, and especially for his investigation into the structure of the fossil plants of the coal-measures."

Prof. Williamson's contributions to biological science were commenced forty years ago, and embrace investigations into the structure of the Foraminifera, the Rotifera, the scales and bones of fishes, and the fossil plants of the Carboniferous and Oolitic periods. These comprise works of great merit and value, not only on account of their accuracy and the extent and novelty of the observations which they contain, but by reason of the breadth of view and the philosophical spirit which pervade them.

His labours in Vegetable Palæontology are above all remarkable, being alike laborious, searching, and productive of important results. These are embodied in six contributions (of which the last will soon appear) to the Philosophical Transactions upon the organisation of the fossil plants of the coal-measures—and one on the restoration of a Cycadeous tree (*Zamia gigas*) from the Yorkshire Oolite, published in the Transactions of the Linnean Society. These are not only models of laborious research and exact description, but they are illustrated by more than fifty plates, devoted to microscopic analyses of vegetable tissues, obtained by making transparent slices of the fossils. Both the slices and the drawings are made by Prof. Williamson himself, who thus, to his reputation as a biologist, unites those of an accomplished artist and a skilful lapidary, qualifications which should be named along with those for which the medal is awarded, because no unscientific lapidary could have obtained equally illustrative sections, and no common artist could have depicted them with equal exactitude. The more important results thus obtained refer to the structure, affinities, and reproductive organs of Calamites and its allies, to Lepidodendron, Sigillaria, Lepidostrobus, Asterophyllites, and to other genera of the Carboniferous epoch.

In addition to these contributions to the history of previously known genera of that epoch, Prof. Williamson has been able to show, on the one hand, that groups of now living plants which were not previously supposed to have a great geological antiquity, actually flourished during the Carboniferous period, and, on the other, that plants of that period which had been previously referred with confidence to groups now living, have in reality other and widely different affinities.

The medal was received by Prof. Williamson.

SCIENTIFIC SERIALS

Astronomische Nachrichten, No. 2014.—In this number appear some interesting observations made by Nicolaus V. Konkoly on the spectrum of meteorites. Some 130 of the August meteors were examined, and it was observed that the nucleus gave a continuous spectrum, the apparent colour of the naked eye predominating in the spectrum. The tail of the yellow meteors gave the sodium lines only, the green one gave magnesium lines, and the red ones strontium or lithium. The sodium lines were present in all. In some of the larger meteors the author suspects the spectrum of iron is present.—Position observations of Coggia's comet are given by Argelander and by Tebbutt, of the Windsor Observatory, N.S. Wales.—Dr. Kleim writes objecting to the explanation of variation of brightness of Jupiter's moons during transit, given by Herr S. Alexander.—Dr. Luther gives position observations of Peitho (118) and elements of Danäe (61).—The elements of Borrelly's comet are given by Grützmacher, and those of Sylvia by Tietjen.—F. Anderson sends an opposition ephemeris of the planet Undina for November and December.—Prof. Spoerer gives observations of sun-spots and protuberances; and observations of the occultation of Venus by the moon, taken at Kiel, are given.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie.—Dec. 1.—In an article on the non-periodic movements of the barometer and the baric windrose, Dr. Köppen, taking into consideration the almost constant cyclonic movement of the air in Europe, asks how it is, while gradients are steepest with west and south-west winds, that when the barometer is observed at equal distances round a minimum centre, it is not found to be highest where the south-west wind is blowing. The mean height of the barometer is on the contrary considerably higher with north and east winds. The explanation lies in the difference between northern and southern Europe with respect to the magnitude of non-periodic oscillations of the barometer.—The low pressure in the north and north-west during the prevalence of south-west winds is not compensated by an adequately high pressure in the south and south-east. Air flows thence either to form a maximum over a small space in high latitudes, or southwards over a large space without causing high pressures. Similarly, but conversely, with north and east winds.—Among the "Kleinere Mittheilungen" we have a notice of Prof. Dove's article on cool Mays after mild Januarys, published in the magazine of the Berlin Academy. Herr Dove regards as proved a tendency to low temperatures in spring after warm winters. It appears that a mild January is generally followed in the interior of continents by a mild May, on the north and east coasts by a cool May, on the Atlantic Ocean again by a May milder than usual.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Dec. 10.—"On the Development of the Teeth of the Newt, the Frog, and certain Lizards, and on the Structure and Development of the Teeth of Ophidia." By Charles J. Tomes, M.A.

The descriptions given by Arnold and Goodsir of the development of the human teeth have been already demonstrated to be in material respects inaccurate as applied to man and other Mammalia; and the present paper shows that the accounts propounded by Prof. Owen, of the process in Batrachia and Reptilia, which are practically an extension of the theories of Goodsir to these classes, are even more at variance with the facts of the case.

There is in no Batrachian or Reptile any open groove or fissure ("primitive dental groove"); there are, at no period of development, free papillæ; consequently the whole process of "encapsulation" has not any existence, but is purely hypothetical. From first to last the whole process of tooth-development takes place in solid tissue, beneath an even and unbroken surface; with which, however, the young tooth sacs have a connection through a band of epithelial cells. The first process is a dipping down of a narrow process of the oral epithelium, the extremity of which, after it has penetrated in some, as the snake, to a great depth, becomes dilated, and is transformed into the enamel organ; and this is the case whether a recognisable coat of enamel is or is not to be found on the perfect tooth. Subsequently to the dipping in of the band of epithelium, and concomitantly with the dilatation of its end, a dentine pulp is formed opposite to it. This may constitute the entire tooth sac, which is then wholly cellular, as in the newt; or it may go on further to the formation of a connective-tissue tooth capsule. The external thin structureless coating of the teeth of Ophidia is derived from an unmistakeable enamel organ, developed as above described; it is therefore enamel, and not cementum, as it is denominated by Prof. Owen. The successional tooth sacs, very numerous in the snakes, are located in a sort of capsule: this character, peculiar to the Ophidia, and most marked in the lower jaw, is of obvious service during the extreme dilatation which the mouth undergoes, as is also the tortuosity of the process of epithelium, before it reaches the collection of tooth sacs. The epithelial band may be traced winding by the side of the older tooth sacs till it reaches the position of the youngest, where it ends in a cæcal extremity, to be transformed into the enamel organ next developed. In fine, the stages of open groove, free papillæ, and encapsulation of the same have no existence whatever in Batrachia and Reptilia, their existence having been previously disproved in Mammalia.

"Experiments showing the Paramagnetic condition of Arteria Blood, as compared with the Diamagnetic condition of Venous Blood." By Richard C. Shettle, M.D.

The experiments consist in suspending between the poles of a powerful electro-magnet arterial blood, hermetically sealed in a glass tube, in a medium of venous blood, and venous blood in the same tube, previously well emptied of its contents, in a medium of arterial blood, care being taken to avoid as far as possible any exposure of the blood to the atmosphere; thus preventing any alteration in its physical characteristics as regards the gases which it contains.

In the former of the two cases the testing tube was found to take an axial, and in the latter an equatorial position.

Dec. 17.—"Note on the Vertical Distribution of Temperature in the Ocean." By J. Y. Buchanan, chemist on board H.M.S. *Challenger*. Communicated by Prof. A. W. Williamson, For. Sec. R.S.

From newspapers and other reports which have been received